AUGUST 1955

AGRICULTURAL Research

Answer by analyzing
● see page 5

Crop by crossing
● see page 10

Profit by planning
● see page 8

UNITED STATES DEPARTMENT OF AGRICULTURE

AGRICULTURAL
Research

Vol. 4—August 1955—No. 2

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Quality

Our food talk these days generally runs to the matter of quantity—producing enough to feed our growing population.

Quantity, however, is not enough. We must also produce food of high *quality*. Our efforts must begin in breeders' test plots and continue through to consumers' dining tables.

Few people realize how much trouble plant breeders take to insure good eating quality and high food value in new varieties. Taste, appearance, and nutritive qualities are among the most important tests that a prospective variety must pass before it is released for commercial production.

We used to think snap beans had to contain a lot of fiber to stand up through rigorous transportation and marketing. But we now have tender, low-fiber beans that don't shrivel or wilt more rapidly than varieties of lower quality.

The Sunnyside sweetpotato released a few years ago for the Chesapeake Bay area contains about 50 percent more carotene than the popular Porto Rico. Our researchers are trying to get more carotene into varieties adapted to other areas.

Our sweetcorn breeders are working hard to develop a higher-quality earworm—resistant sweetcorn for the South. They have evidence that high quality and earworm resistance are inherited and can be combined. We would also like a sweetcorn that will remain reasonably sweet over a longer period.

We're breeding potatoes with higher vitamin C content that they can hold in storage. Since potatoes are so important in the diet of many people, raising vitamin C would be a significant gain. Another goal is higher total solids or dry matter—which means more food in the same size potato.

We're making progress in improving wheat-breeding varieties that will not only produce well but also give a high yield of nutritious flour useful for specific purposes.

We've known for a hundred years that there's a direct link between soil deficiency of iodine and human goiter. But only in recent years have scientists begun to gain insight into the role of mineral elements in the production and quality of food crops and thus in human nutrition.

Those are only a few of the prospects for higher quality. You'll hear more about some of them in future issues.

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AGRICULTURAL RESEARCH SERVIC
United States Department of Agricultur

Recognition FOR RESEARCHERS

Secretary Benson presents awards to individuals and units for accomplishments

AT USDA's eighth annual Honor Awards Ceremony on June 1, Secretary Ezra Taft Benson presented 38 ndividual and 11 work-unit awards to Agricultural Re-earch Service employees for outstanding performance.

A total of 128 individual and 21 work-unit awards were nade to USDA personnel throughout the country.

ARS winners of the Distinguished Service Award:

B. T. SHAW, ARS Administrator, for recognizing the Nation's agricultural research requirements and for lead-ership in outstanding research programs.

Horticultural Crops Research Branch—G. STEINER, for eadership in conducting research on nematodes and their control (AGR. RES., July 1955, p. 8).

Northern Utilization Research Branch—F. H. STODOLA, for advancing the chemistry of micro-organisms leading o the isolation and characterization of many agricultural and industrial products.

Eastern Utilization Research Branch—D. SWERN, for research that has served as a basis for the utilization of surplus animal fats (Mar.–Apr. 1953, p. 15).

ARS winners of the Superior Service Award:

Southern Utilization Research Branch—A. M. ALT-SCHUL and F. H. THURBER, for research leading to new and expanded markets for cottonseed meals in mixed feeds for poultry and swine (Sept. 1953, p. 13).

C. A. FORT, for technological research leading to revo-lutionary changes in outdoor storage of sugar beets.

W. A. PONS, Jr., for developing new methods to deter-mine gossypol in cottonseed and cottonseed products.

E. L. SKAU, for discovering fundamental generalizations permitting prediction of density and solubility data basic to oil and fat utilization, and for devising a general tabulation on such data for industrial use.

Horticultural Crops Research Branch—C. F. ANDRUS, for research resulting in the breeding of commercially new watermelon varieties having high resistance to dis-ease and superior productivity (Oct. 1954, p. 12).

W. S. PORTE, for research in breeding new commercial tomato varieties, resistant to disease and especially suit-able for marketing and processing purposes.

E. SNYDER, for research and guidance on all phases of grape production, variety evaluation, propagation methods, and breeding of superior new varieties.

Field Crops Research Branch—G. W. BURTON, for de-veloping techniques and procedures in breeding and hybridization leading to the development of five Bermuda-grass varieties (Sept. 1953, p. 16; May 1954, p. 16).

J. R. MEYER, for contributions to cotton genetics and breeding research by developing new cytogenetic tech-niques and transference of new characters from wild to cultivated species (Oct. 1954, p. 5).

G. A. ROGLER, for developing improved grass varieties, particularly crested wheatgrass Nordan, contributing greatly to improved agriculture (April 1955, p. 10).

M. STOUT, for technological research leading to revolu-tionary changes in outdoor storage of sugar beets.

Soil and Water Conservation Research Branch—H. A. DANIEL, contributions to a land-judging system and pro-motion of soil conservation practices (Jan. 1955, p. 7).

F. L. DULEY, for research in originating and develop-ing the stubble-mulch system of farming; sustained crop production; and conservation of soil and water resources in the West (Oct. 1954, p. 4; June 1954, p. 10).

Entomology Research Branch—W. C. FEST, for devising and constructing special equipment, facilitating research at the Moorestown, N. J., entomology station.

H. D. SMITH, for diligence and perception in the use of parasites to control the citrus black fly in Mexico, thus contributing to the improvement of the citrus industry of the United States (Dec. 1954, p. 12).

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R. L. WALLIS, for planning and conducting research which provided methods that are now used for predicting potato psyllid outbreaks.

Agricultural Engineering Research Branch—H. P. GASTON and J. H. LEVIN, for developing labor-saving methods for harvesting and handling apples and cherries (Jan. 1955, p. 12; and Feb. 1955, p. 14).

E. B. HUDSPETH, JR., for developing new equipment and techniques for the seeding of row-crops under the semi-arid conditions of the Southwest.

Information Division—D. G. HALL, for developing an information program during the centennial year (1954) of professional entomology that brought wide public understanding of the threat of destructive insects to our national welfare (March 1954, p. 3).

F. L. TEUTON, for resourcefulness in developing and presenting lecture-demonstrations, effectively increasing public appreciation of agricultural research.

Western Utilization Research Branch—F. T. JONES and F. E. YOUNG for discovering, characterizing, and revealing the practical importance of crystalline hydrates of the common sugars, sucrose, and fructose.

Plant Pest Control Branch—C. J. KILGALLEN, for aid in gaining public acceptance of golden nematode quarantine regulations imposed on Long Island industry; for organizing work, and training assistants.

Dairy Husbandry Research Branch—D. V. KOPLAND, for research on breeding stock of which a large percentage of Montana's Holstein herds are founded, and for providing information on dairy feeding and management.

Northern Utilization Research Branch—M. M. MACMASTERS, for contributions to the chemistry, composition, and microscopic structure of cereal grains; and for interpretations of scientific results.

Animal and Poultry Husbandry Research Branch—M. W. OLSEN, for pioneer research in the field of fertility and hatchability of eggs leading to numerous findings of value to science and the poultry industry (Nov. 1953, p. 6; May 1954, p. 4; Nov. 1954, p. 3).

J. R. QUESENBERRY, for leadership of the U. S. Range Livestock Experiment Station, Miles City, Mont., which has sustained and stimulated a complex and highly productive research program (Jan.–Feb. 1953, p. 5).

J. H. ZELLER, for leadership in developing the meat-type hog designed to meet demands for leaner cuts of pork and the production of less lard (Sept. 1953, p. 8).

Meat Inspection Branch—C. H. PALS, for competence in handling a delicate international problem concerning lard exports from the United States.

F. L. WILDE, for organizing and developing the handling of production and inspection reports covering over 1,000 federally inspected meat-packing plants.

Animal Disease and Parasite Research Branch—G. S. TEMPLETON, for contributions to fundamental knowledge and practice of rabbit research and production—basically, commercial raising for meat production and control of rabbit losses through nutrition (Dec. 1953, p. 10).

Eastern Utilization Research Branch—M. E. WALL, for contributions to the chemistry of steroidal sapagenins, precursors of the drug cortisone, and leadership in developing this program.

ARS work units cited for Distinguished Service:

Northern Utilization Research Branch—DEXTRAN TEAM, for research leading to an early and economical production of a blood plasma substitute (Aug. 1954, p. 3).

Entomology Research Branch—LIVESTOCK INSECT LABORATORY, Kerrville, Tex., for developing and demonstrating new and safe methods of controlling insect pests of livestock (Aug. 1954, p. 14).

ARS work units cited for Superior Service:

Western Utilization Research Branch—EGG SOLIDS RESEARCH GROUP, for discovering the chemistry of the principal type of deterioration of whole egg and yolk solids, contributing to greatly improved egg solids for domestic and armed forces use (May–June 1953, p. 15).

FRUIT JUICE CONCENTRATE RESEARCH GROUP—for developing a process for converting culled strawberries into frozen concentrated juice, especially adapted for jelly.

POTATO GRANULE RESEARCH GROUP—for developing improved equipment and processing for the manufacture of dehydrated mashed potatoes (Feb. 1955, p. 12).

SUGAR BEET RESEARCH GROUP—for research leading to the improvement of the sugar beet technology by devising and applying methods for identifying non-sugar components of the sugar beet and its processing liquors.

DAIRY HUSBANDRY RESEARCH BRANCH—Cheese Investigations Unit, for developing a time and labor-saving method of manufacturing improved cheddar cheese from pasteurized milk (May–June 1953, p. 13).

EASTERN REGIONAL RESEARCH BRANCH—Fruit Essence Research and Development Group, for developing a process for recovering valuable flavors of the fruit preserve industry (Aug. 1953, p. 11).

DAIRY WASTE UNIT, for research leading to inexpensive plants for the treatment of milk-processing wastes to prevent stream pollution (Mar. 1955, p. 4).

ENTOMOLOGY RESEARCH BRANCH—Diptera Unit, for increasing and applying knowledge of the two-winged fly to protection of agriculture and public health.

ANIMAL AND POULTRY HUSBANDRY RESEARCH BRANCH—Egg Candling Project, in cooperation with Agricultural Marketing Service, for measuring the quality of intact eggs by electrical devices and for progress in methods and equipment for grading (Oct. 1954, p. 11).☆

LEAVES TELL THE NUTRITION STORY

Leaf Analysis How it's Used

Analysis technique is helping scientists find answers to citrus and tung problems

Effects of different nutrient solutions are measured by leaf analysis of these citrus trees planted ıd. Fertilizer recommendations have come from r plot studies. Such sand cultures are valuable in on research—they give prevailing soil tempera- ınd good drainage, allow good root development.

Leaf analysis has helped show that soil acidity—not type of nitrogen fertilizer—is most important. ɫeveloped roots (left) were grown in slightly acid) nutrient solution with ammonium source of nitro- Skimpy roots developed with long-favored nitrate of nitrogen, but in more acid (pH 4) solution.

BETTER than any other research tool, leaf analysis reveals the inside story on plant nutrition.

In Florida, USDA citrus and tung scientists credit leaf analysis with an essential role in—

1. Boosting Florida's average citrus yield to 350 boxes per acre, compared to 150 boxes 20 years ago.

2. Developing tung from a new plant introduction (1905) into a crop worth as high as $10 million a year.

Leaf analysis provides vital information for general citrus and tung fertilization recommendations. Big citrus producers use leaf analysis to answer hidden nutritional problems and to help produce fruit for a specific market. Through leaf analysis, tung researchers have been able to correlate leaf appearance with nutritional deficiencies in the orchards.

Now, ARS scientists at the U. S. Horticultural Field Station, Orlando, Fla., are using leaf analysis in studies of such things as soil acidity (pH) and nitrogen source and their effects on nutrient use by citrus. At the Tung Research Laboratory, Gainesville, leaf analysis is determining tree needs for such minor elements as boron and molybdenum. For these scientists, leaves have had most of the answers for efficient, high production. Leaves are not only food factories where chemicals become growth factors but are also a tree's reservoir for nutrient minerals.

Being able to "look into" these leaves has enabled the researchers to establish in only a few years an understanding of nutrient needs that would have taken decades with fertilizer trials and soil analysis.

Leaf analysis has world-wide significance. In any country where citrus or tung research has lagged, leaf analysis (interpreted in terms of research in Florida) could show deficiencies, and corrective fertilization could be recommended. Equally important, leaf analysis could rule out nutritional deficiency as a reason for poor growth if some other factor—for example, disease or soil management—was to blame.

By growing citrus and tung in sand or water to which all nutrients are added, then analyzing the leaves for these nutrients, researchers have established optimum levels for all important elements. By changing this

3. A commercial application of leaf analysis is demonstrated here. Large fresh-market-size fruits are produced when potassium is plentiful. A smaller, sweeter orange, suitable for juice, results when potassium levels are low. However, the total weight of fruit per tree is practically the same under both treatments.

4. Is potassium the only factor in fruit size? These sand-grown Valencias will be fed constant levels of potassium, but different levels of calcium and magnesium. Analysis has shown that when potassium levels are high, calcium and magnesium tend to be low. Scientists think it's really calcium that controls size.

5. Tung trees set last spring in these plastic, sand-filled wastebaskets will be 4 to 6 feet high this fall. Scientists are altering nutrient solutions fed this year in an effort to determine calcium and boron requirements in terms of the type of nitrogen fertilizer used. Leaf analysis will help provide answers.

nutrient balance, the scientists have learned about the interrelationship among the elements.

Twenty years ago, Florida citrus growers largely confined groves to the "better" heavy soils, using a fertilizer that included 3 percent nitrogen, 8 percent phosphate, 8 percent potash, 2 percent magnesium oxide, 1 percent manganese oxide, and ½ percent copper oxide. Knowledge gained through leaf analysis has allowed extension of citrus groves to lighter soils. And fertilizers have been modified until growers now use a formula that contains nearly three times as much nitrogen (8 percent), no phosphorus, the same amount of potash, more magnesium oxide (3 percent), and no manganese or copper.

Leaf and rootlet analysis has enabled growers to correct copper toxicity by liming heavily (lime immobilizes copper; this, in turn, frees roots to absorb other nutrients). Researchers have found that calcium and magnesium deficiencies can be induced by applying too much potassium. And trees showing low levels of phosphorus, sulfur, or potassium may be getting too much nitrogen.

In developing tung, researchers have been able to recommend heavier nitrogen and potassium and lighter phosphorus fertilization and to include such minor elements as copper, magnesium, zinc, and manganese.

Currently, leaf analysis is being used by plant physiologist P. F. Smith at Orlando to determine the effect of different soil acidities on nutrient uptake by citrus roots.

Thus far, Smith has disproved the common belief that citrus cannot make use of nitrogen supplied as ammonia rather than as nitrates. By maintaining nutrient solutions in the pH 7 to 6 range (neutral to slightly acid), he has been able to get citrus to prosper as well on one source of nitrogen as the other.

Through leaf analysis, he has shown that nitrogen is readily taken up from ammonia sources even when the pH is 4 (moderately acid). But the presence of this form of nitrogen plus the hydrogen ions in the nutrient solution interfered with the plant's uptake of two other essential elements—potassium and magnesium. Chemically, the ammonium cation competed so well that only limited numbers of the potassium and magnesium cations were absorbed by the roots. This very problem of cation competition results in low potassium in California citrus groves that are high in calcium.

The day may soon arrive when more growers will regularly look to commercial leaf analysis service to provide information they need in planning their fertilization programs.

With some of these crops—tung, for example—an observant grower may be able to get the information he needs for corrective fertilization by comparing certain visible deficiency symptoms on tree foliage with the knowledge of such symptoms gained through leaf analysis. In other instances, however, these symptoms may be concealed or made unrecognizable by the level of other elements in the leaves or by other abnormal grove conditions. With most tree crops, visible symptoms may appear only after several years of nutritional deficiency—a period that may otherwise be marked with lower-than-normal yields of fruit.☆

Leaf Analysis
How it's Done

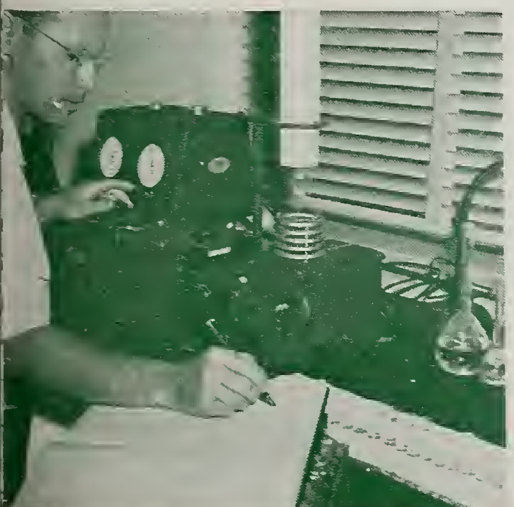
1. The value of leaf analysis depends upon standardization of leaf-sampling methods. Here, P. F. Smith selects those citrus leaves that were produced in the spring, lying behind the summer flush of growth. Leaves are taken one from a twig from several branches of each tree. These branches are fruitless or non-bearing.

2. A routine washing of citrus leaf samples in detergent, then rinsing and drying, removes the dust and chemical residues in the first step of preparing a leaf analysis sample. The job is done here by biological aid G. Hrnciar at the U. S. Horticultural Field Station, Orlando. About 40 leaves make up a good sample.

Leaves are ground and dried to a constant moisture level in this 65° C. oven—an overnight operation—in preparation for further processing. The leaf analysis technique is being used by citrus growers to ... hidden nutritional problems, by tung scientists in ...lating leaf appearance with nutritional deficiencies.

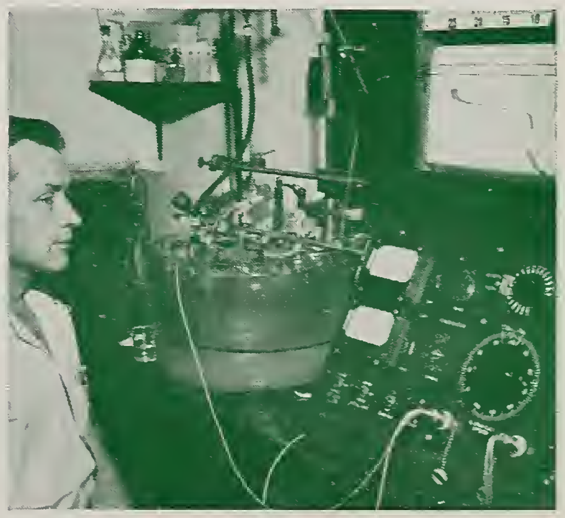
4. Ground and dried citrus leaf samples are carefully weighed out by the researcher. Amount varies with the type of test: 200 milligrams (about 1/142 ounce) for samples to be analyzed on flame photometer (see 6) for one group of elements, 100 mg. for samples tested colorimetrically (see 7) for another group.

5. Weighed samples are reduced to ash in this 500° C. oven. The sample in each crucible will eventually reveal nutritional information about an entire experimental plot of citrus trees. Researchers can analyze 500 samples (representing as many orchards or research plots) a year, determining 5 to 10 elements per sample.



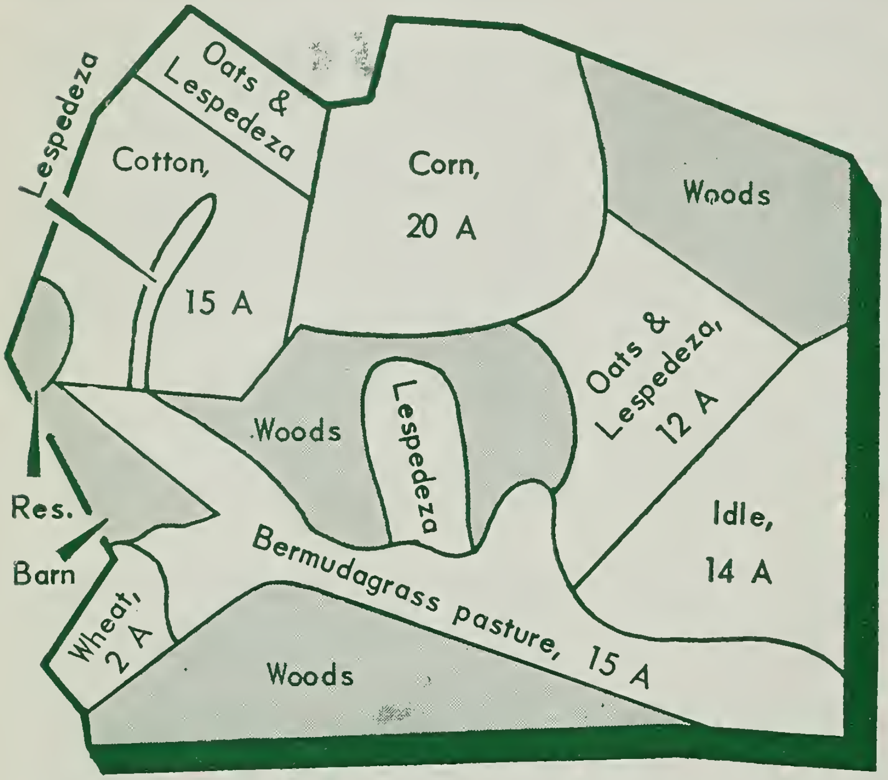
Acid solutions of ashed leaf are analyzed on flame photometer to find amounts of potassium, calcium, ...gnesium, sodium. Air pressure atomizes the solution ...ugh jet into a hydrogen flame. Wave lengths from ... vapor are picked up by quartz prism, electrically ...nslated into a quantitative measure of the element.

7. Color spectrophotometer is used to analyze acid solutions of ashed leaf samples for their content of nitrogen, phosphorus, copper, zinc, manganese, boron, and iron. This apparatus measures the color intensity of an indicator solution. These measurements are recorded and translated into percentages of each element.



8. At the Gainesville tung laboratory, chemist H. L. Barrows uses polarograph in improved technique to determine zinc and manganese in only 5 to 10 minutes. Acid solution of ashed leaf is put between positive and negative electrical conductors of mercury. Current's flow through solution quantitatively measures element.

Farm Planning CAN REALLY PAY



PRESENT FARM SYSTEM. This rolling 74 acres of cropland (on a 132-acre farm) was wasting away under a cash-crop system that didn't fit needs of soil or farmer. Half was row-cropped. A fifth of it lay idle. Poor work distribution wasted family labor. Income, mostly from cotton, failed by $250 to finance the farm's upkeep. The land called for better ground cover—small grains and forages—to hold soil. The farmer needed profitable production methods, and a way to use family labor more fully.

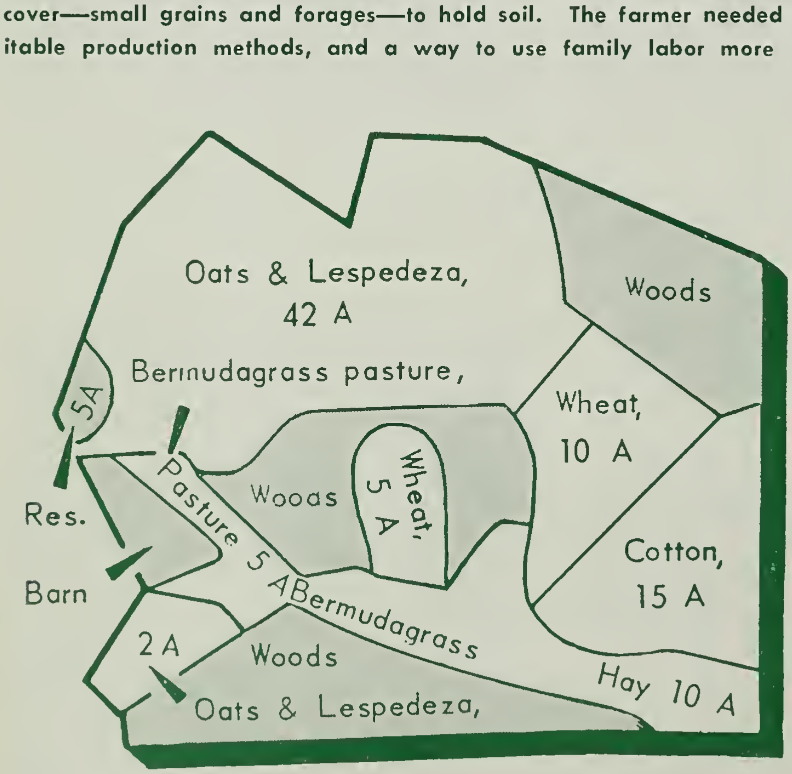
Suitable enterprises and efficient methods must combined so as to make good use of resourc

BETTER FARM PLANS fully using land, family lab and other resources could mean a much better livi from family farms in the country's southern Piedm area. That's the rolling to hilly land lying between Coastal Plain and the Appalachian Mountains.

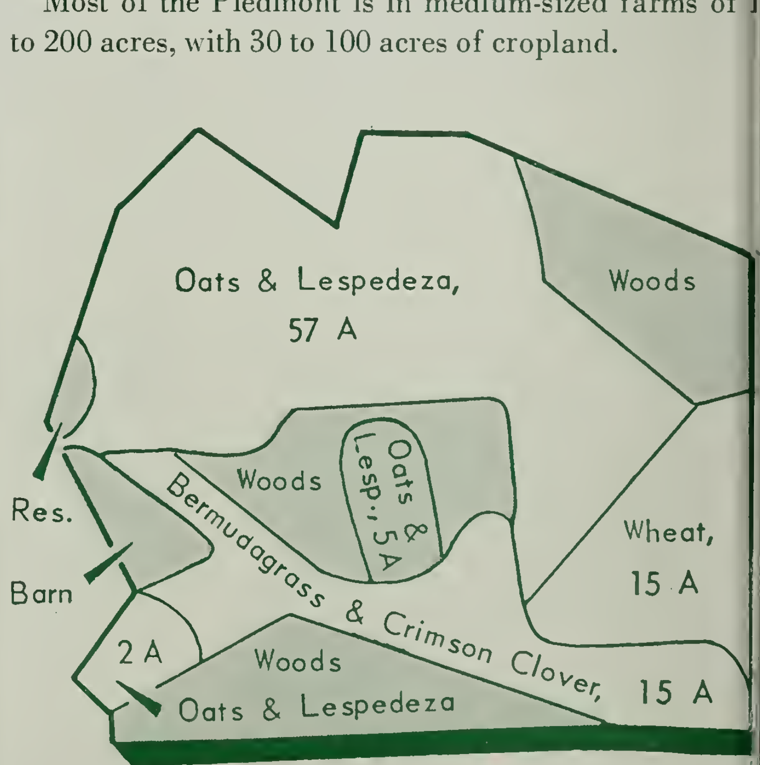
More important, perhaps, is the unlocking of latent fa management ability that most farmers have but don't fully. To motivate this ability, USDA economists h worked out some illustrative farming systems that mi start many farmers in the right direction.

Naturally, the varied kinds and amounts of land, bui ings, livestock, and—yes, varied farmer aptitudes— for a wide assortment of farming systems. But ma farmers could adapt one of the illustrative farm pl to their needs. And any farmer can get help from county extension agent or experiment station speciali in improving his plan and modernizing his methods

Most of the Piedmont is in medium-sized farms of 1 to 200 acres, with 30 to 100 acres of cropland.



PLAN I—COTTON AND SMALL GRAIN. In simplest improvement, better crop layout, methods, and power net about $1,800. Cotton moves to levelest land (now idle), oats-lespedeza to most erosive land (now in row crops or wheat), and wheat to gentler slopes (now in oats-lespedeza). Forages are grown mainly for the seed crop.



PLAN II—SMALL GRAIN AND CATTLE. All-year cover of sm grains and forage to hold the soil and return valuable seed c grain crops, a ten-cow beef breeding herd to use up the fora double-cropping, heavy fertilization, and various other go practices would return a net farm income of $2,700 a ye

An ARS study of a cotton farm located in the South arolina uplands—132 acres with 74 acres of cropland, pical of Piedmont farms—showed that conservation arming with livestock is one of the best ways of using all f the open land. That not only conserves the soil but lso spreads the work so the family can do most of it.

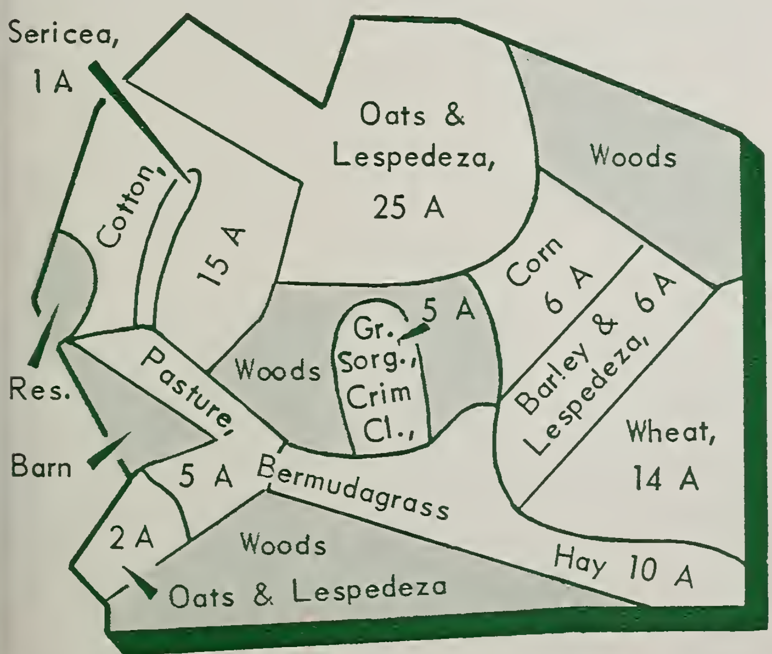
ARS economist C. P. Butler, working in cooperation with he South Carolina experiment station, found that this armer had some idle land. Too much of the work came in pring and fall—called for too much hired labor in proporion to income. And there wasn't enough work the rest f the year to keep the family busy. Current farming asn't paying enough to cover depreciation and keep the arm up. This farm had a team of mules and a tractor, either of them fully equipped or fully used.

Simplest adjustment proposed (Plan 1) would shift otton to the best land (now idle), discontinue corn, put iore land in wheat (on the moderate slopes), and use all teep fields (now largely row-cropped) for oats top-seeded lespedeza for the seed crop. Grain would provide inter grazing and pastures an adequate hay cutting for amily cows. Technology advised by extension or experiient station specialists—better seeds, varieties, and fertiization—would help replace the current deficit with a 1,800 return for labor, capital, and management. Mules nd mule implements would be sold, the tractor better quipped, and a new machinery shed and grain crib built t a new-capital cost of $1,500.

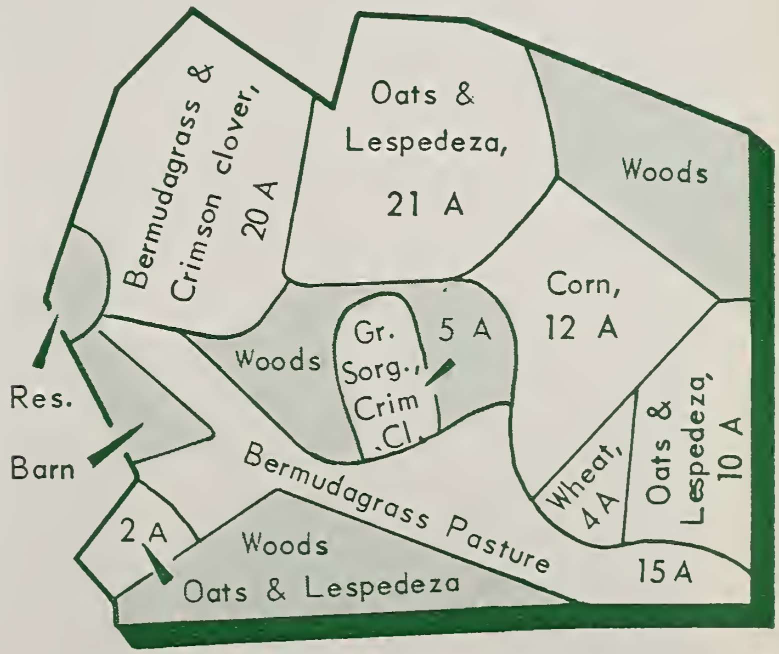
The simplest shift to livestock—a herd of eight beef ows producing calves to sell (Plan 2)—would employ $4,000 of new capital to advantage and raise net farm income to about $2,700. Less family labor would be needed, and hired labor would be cut by two-thirds. All cropland would go into the fully mechanized small-grain crops, supplying valuable winter grazing as well as grain. Lespedeza for seed would follow oats, as in the plan previously described. And the Bermuda-grass pasture would be topseeded with crimson clover for winter and spring grazing—5 acres to be harvested for clover seed.

As a step in the direction of dairying and substantial profit, the operator could add eight milk cows and produce grade B milk for manufacturing (Plan 3). He'd net $1,800, about the same as with cotton and small grain. That would take about $4,000 new capital (same as for the beef-calf program) for stock, machinery, dairy equipment, a new shed, feed, and starting a new pasture. The farmer would maintain his cotton acreage and improve its yield but substitute small grain and grain sorghum for three-quarters of the corn acreage. This plan would use family labor more fully, but without comparable gain.

The small grade B dairy has one big advantage, however. In a year's time the herd would be a going concern and could be shifted immediately or gradually into a 30-cow herd producing grade A milk (Plan 4). That would take an additional $13,000 capital—$9,000 more than the grade B herd. Much of this new capital could be self-produced if the farmer waits for normal herd increase. This system would take twice as much hired labor as is presently used but would probably raise the operator's net farm income to $6,500 at present prices.☆



PLAN III—DAIRY FOR GRADE-B MILK. A ten-cow herd supplying milk for manufacturing would take $4,000 new capital to buy cattle, to improve land and buildings, and to supply needed feed. The plan would net about $1,800 but give a big start toward the more remunerative dairy farm of Plan IV.



PLAN IV—DAIRY FOR GRADE-A MILK. This 30-cow herd takes $12,000 to improve the physical plant and buy feed and cows. Starting under Plan III, herd increase would spread $5,600 cost for cows over several years. Plan IV makes fullest use of family labor and should net $6,500 for labor, capital, and management.

crops
and soils

New southern forage crop

SORGHUM-JOHNSONGRASS CROSS PRODUCED THIS PROMISING PLANT NOW IN FINAL FIELD TESTS

HYBRIDS such as this sorghum-Johnsongrass first cross marked initial efforts to produce a new southern forage crop. Many promising plants are being developed from the hybrids.

NEW forage-crop plants—crosses of sorghum and Johnsongrass growing to 18 feet and yielding more than 30 tons an acre—are being developed in cooperative research between USDA and the Mississippi experiment station at State College.

Now under field-evaluation tests before possible release, the new plants promise increased opportunity for livestock production and diversified agriculture in the South.

Selected from about 34,000 original progeny, the segregates under test represent those found most palatable to cattle, sheep, hogs, and mules. Three basic types have been developed—one resembling sorghum, another resembling Johnsongrass, the third an intermediate type.

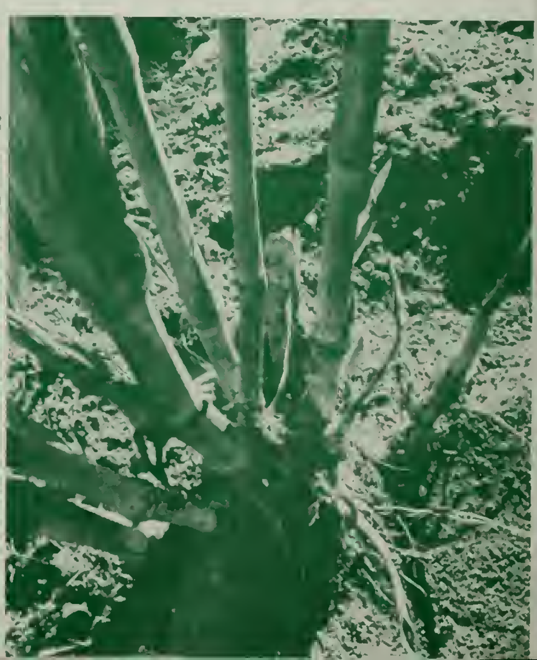
The new varieties combine the valuable feed carbohydrates of sorghum and the perennial habit of Johnsongrass. This was the big goal sought by agronomist H. W. Bennett and his associates 8 years ago when the project was little more than an idea.

Similarity between sorghum and Johnsongrass ends with the fact that both belong to the grass family. Sorghum is an annual having 10 pairs of chromosomes, Johnsongrass a perennial having 20 pairs. (Chromosomes are microscopic cell bodies that control development of plant character and are the carriers of inheritance.) Crossing plants of the same species is a relatively simple matter if chromosome numbers are equal. If they are not equal, the task is difficult—often impossible.

Bennett's sorghum - Johnsongrass hybrids were produced by hot-water emasculation, followed by pollination. The sorghum (Hodo) heads were

ENCASING sorghum flowering head in rubber tube help make first cross. Hot water poured in tube destroyed sorghum pollen, then Johnsongrass pollen was dusted on the head.

PERENNIALS were desired by the Mississippi researchers, so they selected first crosses that had inherited the rhizomes of Johnsongrass. The scientists eliminated plants like that shown at left, which has widely spreading rhizomes similar to those of Johnsongrass. Typical of compact rhizomes obtained in the new plants under field test are those of plant at right.



trimmed, leaving florets that would bloom next day. These florets were immersed for 10 minutes in water at 47° C. Johnsongrass pollen was dusted on the florets for the next 3 days. Crosses haven't been produced using Johnsongrass as female parent.

Palatability tests followed, since there was little reason to produce a forage plant that livestock wouldn't eat. With 2,600 different types of F_2 plants from which to choose, Bennett selected many from what he thought might be "the cow's viewpoint." These he tagged. The cows ignored them. He let the cows choose. They picked 115 plants out of the group and showed their appreciation in three trials by eating stalks and all. With this information right out of the cows' mouths, Bennett selected—as the cows had—those plants that had juicy, succulent stalks.

Researchers wanted to retain the all-important perennial habit of Johnsongrass in the new plants. This meant concentrating their efforts on the Johnsongrass rhizome that the hybrids had inherited. Progenies of the hybrids were used in attempts to select those having the perennial habit. The progeny segregated into approximately 75 percent with rhizomes, 25 percent without them. Out of the selections, however, came a number of perennial types that were hardy enough to stand the winter temperatures in Mississippi as low as —3° F.

There was still another problem. Sorghum grows from seed, Johnsongrass either from seed or vegetatively from its rhizomes. The rhizomes wander through the soil in all directions from the parent plant and send up new shoots of grass. Careful selection made it possible to obtain types with more compact rhizomes. The results were plants that grew compactly above and below ground. One of them, for example, has produced 32 tons of forage each of the last 4 years in plantings spaced 6 feet each way. Grass types have produced as much as 14 tons an acre—3 tons above the average yield of silage crops in Mississippi.

The new plants have many advantages. They grow during August and September in the South when little else grows. They provide high quality grazing or silage. Even in hot weather, the yield should support up to 8 cows an acre. With a small amount of concentrate—cottonseed meal, for example—they should provide low-cost, balanced rations for livestock. The seed is small—barely half a pound seeds an acre.

Field tests being made this year will determine the degree of adaptability the selections have attained. If the tests of the three types prove successful, releases of at least some may be expected as soon as seed supplies are available.☆

livestock

SHEEP GET FOOD OUT OF FARM WASTES

■ A WAY TO UNLOCK some of the vast store of nutrients in generally-wasted corncobs, sugarcane bagasse, and low-quality hays is to let the bacteria in a sheep's rumen do it.

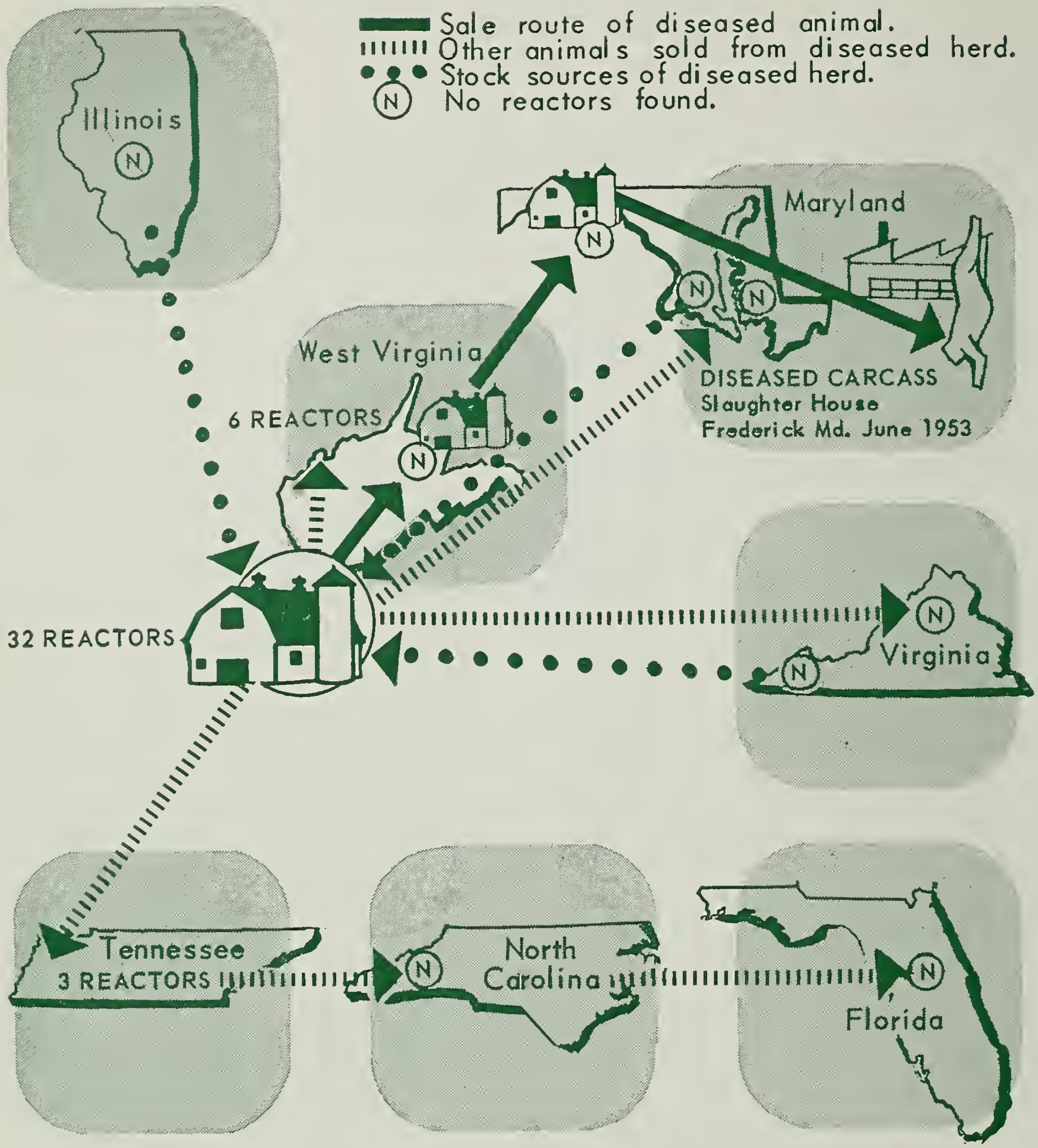
Rumen bacteria can digest two-thirds to three-fourths of the nutrient material in a pelleted combination of such ground roughage along with an equal weight of a high-energy concentrate. But it takes lots of bacteria to get much nutrient value out of the roughages. Sheep fed these roughages alone have far too few ruminal bacteria for the job.

That's where the high-energy supplement comes in. Bacteria use it to multiply rapidly in the rumen. That sets a force of bacteria to work on the roughage celluloses—breaking them down into volatile acids. Sheep digest not only the acids, but also most of the bacteria themselves—a nutritious protein food.

This role of bacteria was shown in studies conducted at USDA's Agricultural Research Center, Beltsville, Md. (see also AGR. RES., Feb. 1955, p. 11; May 1955, p. 6). Three lots of sheep were fed a concentrate composed of 10 percent blackstrap molasses, 20 percent alfalfa meal, 30 percent corn distiller's grains with solubles, 18 percent soybean oil meal, 20 percent ground corn, 2 percent salt. Each lot was fed an equal weight of roughage—cobs, bagasse, or poor grass hay.

By weighing and assaying nutritionally the feed consumed in the test and the undigested excretions, ARS biochemist I. L. Lindahl found that the animals utilize about two-thirds of the main nutrients in roughage—the dry matter, crude fiber, crude protein, ether extract, and nitrogen-free extract. All digestion values were high for cobs—most efficient of the three roughages. Crude fiber and dry matter were less well digested in poor grass hay and bagasse.

It is noteworthy that cattle and goats, like sheep, have the extra stomach (rumen) that predigests rough feed. They're a potentially valuable outlet for farm byproducts that have little market value today.☆



DON'T FORGET ABOUT TB

Complete eradication calls for continued action

OUR livestock industry can look with pride at the tremendous success of the Federal-State cooperative tuberculosis eradication program. However, if this accomplishment leads to a spirit of complacency, it can become a stumbling block.

The incidence of this disease, as shown by the number of reactors found among cattle tested, has been reduced from almost 5 percent in 1918 to 0.11 percent in 1954. But as long as one tuberculous animal remains, the job is incomplete.

In the early days of the eradication program, it was not so much a question of *where* the infection was but *how much*. Competition developed among the States to be first to attain the status of a "Modified Accredited Tuberculosis-Free Area" — which means an infection rate of less than 0.5 percent. The goal was reached on a national basis in 1940.

It might have appeared on the surface that the job was done, but the hardest task lay ahead—stamping out the *last* of the disease. Increased efforts were needed to improve testing procedures and techniques.

One recent outstanding contribution by USDA research to tuberculosis eradication was the discovery that the cervical area provides a more critical response following injection of tuberculin. Thus another method of testing, in addition to the tried-and-proven caudal-fold method, has been added to the program.

The new findings on the cervical test and its field application have definitely helped in locating infected animals in problem herds. This benefits livestock owners since it more critically designates the infected animal and hastens its elimination. That frees the herd from tuberculosis in a much shorter period, thus preventing further spread of the disease.

In addition to improved testing procedures, a system was developed for tracing back to the herds of origin animals that on regular kill showed tuberculous lesions on post-mortem meat inspection. The chart illustrates how this practice has helped locate other infected animals and kept the disease from spreading.

These two research developments came out of a constant effort to improve techniques and methods. But with all the advantages of such findings, an eradication program can't succeed without the cooperation of livestock owners. Some of the many ways they can help are:

1. Being constantly aware of the perpetual danger of tuberculosis.

2. Testing all animals in the herd regularly and all replacements before they are added to the herd.

3. Providing sufficient equipment and personnel at the time of testing so that careful injections and observations can be made.

4. Disinfecting the premises after removal of an infected animal.

The excellent progress towards eradication of bovine tuberculosis would not have been possible without the wholehearted support of the livestock industry. If the goal of eradication is to become a reality, this support must be continued.☆

Our cows are heftier today

DAIRYMEN CAN PICK BETTER WITH THESE NEW GROWTH STANDARDS

LIKE American children, our American dairy cattle now outstrip earlier generations in size.

That's why USDA scientists have developed new sets of higher growth standards that farmers can use in their own herds of Jersey and Holstein cattle. These standards were evolved from detailed records of experimental breeding herds long maintained at the Agricultural Research Center, Beltsville, Md.—Holsteins since 1918, Jerseys since 1921.

Beltsville herds have been maintained for study of inheritance laws for milk and butterfat production. The practical methods of feeding and management, kept fairly constant through the years, are much like those found on any good dairy farm.

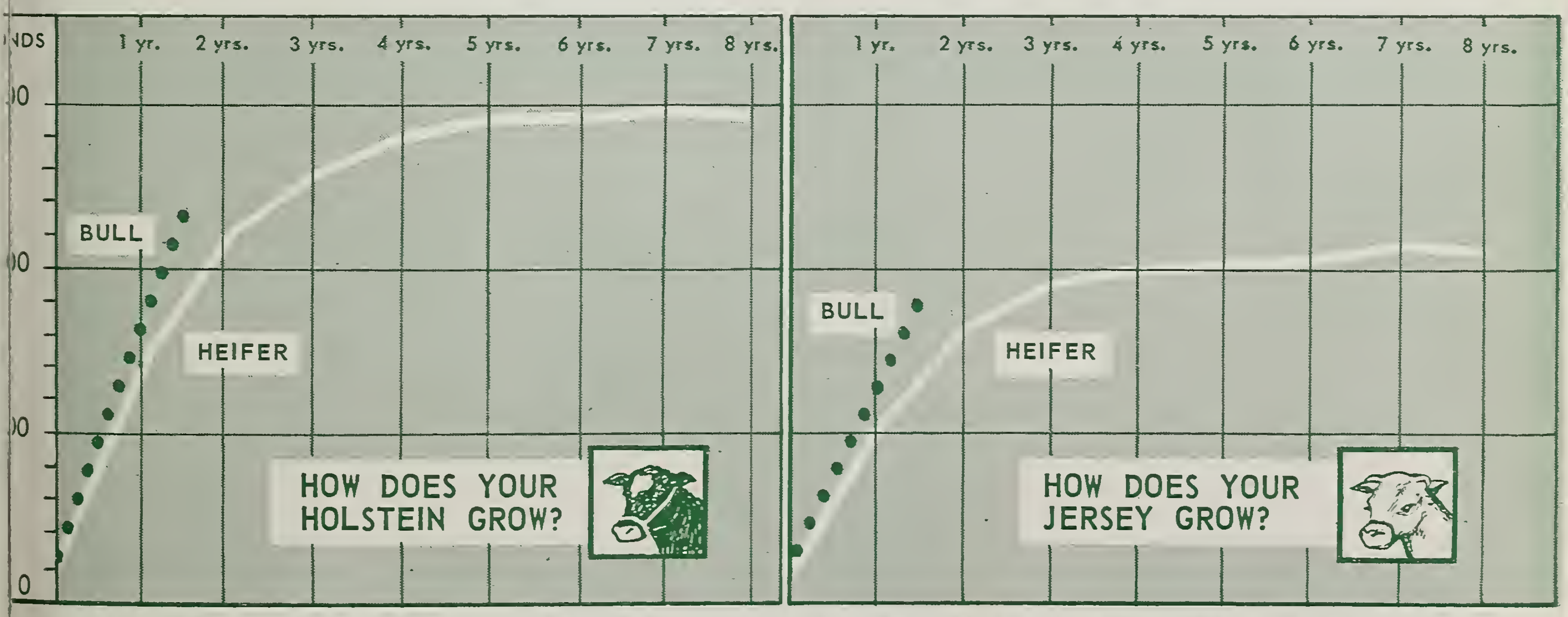
Cattle weights in earlier growth standards of 20 years ago run well below present averages. Early Jersey standards probably included the smaller, more refined Island-type Jerseys; new standards for larger, more rugged American-type Jerseys can now be applied as standards of normal growth for all our Jersey cattle.

Standard birth weight is 56.4 pounds for the average Jersey heifer calf, ARS dairy husbandmen C. A. Matthews and M. H. Fohrman found. At 6 months and about 277 pounds, the average heifer has reached about a quarter of her mature weight. She is usually half-grown a month or so past her first-birthday weight of almost 519 pounds. At 2 years—and over 807 pounds—she is almost three-quarters grown. She weighs most—close to 1,100 pounds—at a little past 7 years, then loses weight slightly for the 2 or 3 years that follow.

Holstein proportions are similar. Standard average birth weight is 93.6 pounds. At 6 months and 26 percent of her mature weight, a heifer weighs 393 pounds. At a year she has made 47 percent growth, or 712 pounds. At 2 years and 1,115 pounds she has almost 74 percent of her top 7-year weight, around 1,509.

Ten weight grades for heifers from birth to 21 months were also set up. In Grade 1, for instance, are Jersey calves weighing up to 45.7 pounds at birth, and heifers weighing 653 pounds or less at 21 months. Top-range Grade 10 calves include those weighing 65.7 pounds and up at birth and those reaching 829 pounds at 21 months. Calves, particularly small ones, often shift grades as inheritance and feeding dictate.

Dairymen can combine weight grades, regardless of heifers' ages, to get an early idea of relative size of a certain sire's offspring. Combined weight grades can point up feeding or management conditions retarding a herd's normal weight growth. Differ-



AVERAGE Holsteins and Jerseys develop along these curves, which represent Grade 5 on weight-grade scales from 1 to 10 worked out in studies of Beltsville herds. (Weight differences between standards of two breeds is not significant as a measure of producing ability.)

ences in grades for different periods reveal how some calves, underweight at birth or retarded by sickness, overcome early handicaps. Weight grades offer the dairyman a stick for measuring his own herd against scientifically established standards.

Also, even though the relationship between body weight and milk and butterfat production has not been established, weight grades may help earmark heifers for later culling. At 6 months, for instance, a Jersey heifer weighing less than 267 pounds rates Grade 3 or below. Even if good feed and care raise her to a higher grade, such a calf will probably never gain enough to reach a weight between grades 5 and 6, which is average. The older the heifer, the more reliably weight standards can forecast mature lactation weights, researchers Matthews and Fohrman found.

There is one significant contrast between the two Beltsville herds. No outside sires or females were brought into the Jersey herd during the later years of the breeding experiment. Average weights increased rapidly for the experiment's first 10 or 12 years, then declined slowly during the remaining 18 or 20 years. In the Holstein herd, on the other hand, outside sires were used continuously and weights never showed a definite downward trend in the experiment.

Apparently, in a breeding program of outcrossing to sires proved for high production, average weights in an assembled dairy herd will increase from 2 or 3 generations and then level off. Then, if the herd is closed to outside blood lines, average weights will probably go down.

Standards similar to those for heifers were developed for measuring growth of bulls up to 18 months of age. Bull calves, weighing more than heifer calves at all ages, grow proportionately larger than heifers as they grow older—Jersey bulls even more than Holsteins. The average Holstein bull calf, weighing around 100 pounds at birth, weighed more than 1,150 pounds at 18 months.

Detailed weight and grade tables of cows, by age-limit groups and during pregnancy and lactation, are given in USDA Technical Bulletin No. 1098, *Beltsville Growth Standards for Jersey Cattle*, and Technical Bulletin No. 1099, *Beltsville Growth Standards for Holstein Cattle*.☆

poultry

NEW STATION'S AIM: BETTER BROILERS

■ POULTRY BREEDING research is keeping pace with the South's thriving broiler industry by adding the new Southern Regional Poultry Testing Station at the University of Georgia, Athens. Private industry, the Southern States, and USDA are in on this cooperative project.

The new station will be devoted primarily to testing meat-type chickens to evaluate progress in the breeding research of 13 cooperating State experiment stations.

In general, the work program on broiler stocks to be conducted at Athens is similar to the pattern followed on egg-producing types at the North Central States Regional Testing Station at Purdue University, Lafayette, Ind. (AGR. RES., July 1955, p 11). Major objective at both is development of improved methods of breeding more productive poultry.

The new station will include "laying cages" to handle 1,200 single birds in the testing of broiler breeds for egg-laying ability and other factors such as feed consumption, fertility, and hatchability. Use of laying cages is relatively new in performance testing and is made feasible by the mild climate at Athens.

The cages are housed in an ordinary poultry house. They are constructed of wire, including the floors, which are arranged so that eggs roll gently out of the way until they can be gathered and recorded. Similar to the laying "batteries" long used in poultry research laboratories, these cages are suspended from the roof and are only 1 tier high instead of the usual 3 for batteries. Each house has 4 rows of cages.

Since the cages permit keeping an accurate record on individual performance, researchers see in their use an improved means of determining the number of birds needed for good random-sample tests.

The cages, two brooder houses with a capacity of 4,000 chicks each, and a hatchery make up the present broiler-clinic facilities at Athens.

The new station is located on 50 acres of land provided by the University of Georgia. Private industry contributed $45,000 toward the $75,000 construction costs.

The Technical Committee of the Southern Regional Poultry Breeding Project, which includes a breeding specialist from each cooperating State, has over-all supervision of the testing work. States are Alabama, Arkansas. Florida, Georgia. Louisiana. Kentucky, Mississippi, North Carolina, Oklahoma, South Carolina, Tennessee, Texas, and Virginia.☆

What is FLY FACTOR?

■ CAN YOU IMAGINE HUNGRY FLIES TURNING DOWN SUGAR? Most of them do when they can feast on sugar *plus*—the plus being something that USDA scientists refer to as "fly factor." Fly factor is thus far an unknown that apparently is carried to or deposited on food by feeding flies. It makes the food more attractive to other flies.

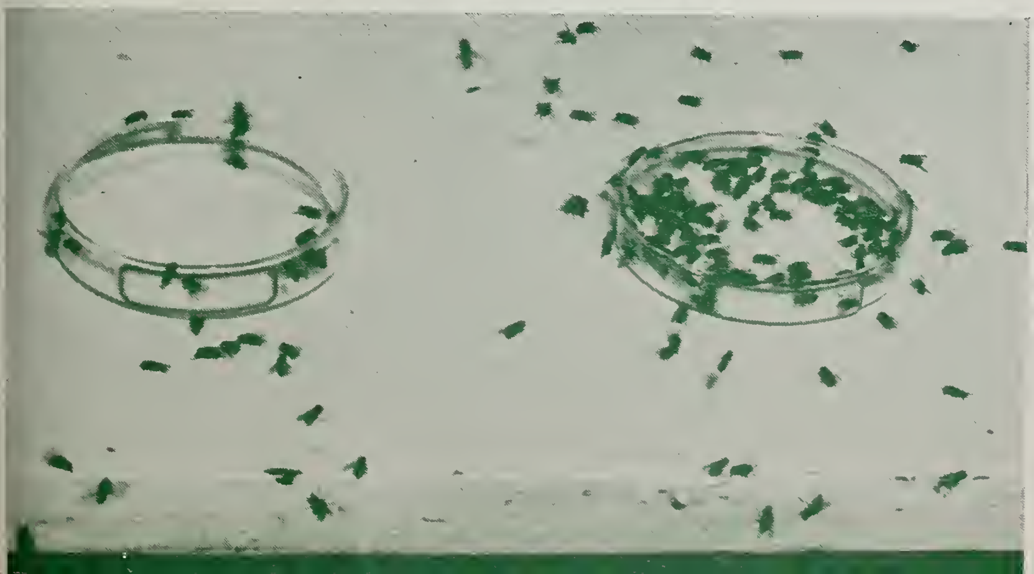
This phenomenon was first reported in 1948 by Army scientists. Now entomologists at the ARS laboratory at Orlanda, Fla., have successfully extracted fly factor from sugar fed on by flies. Furthermore, the researchers have re-introduced fly factor into other sugar.

J. H. Keller, who directs fly-control research at Orlando, says that fly factor has been collected by saturating fed-upon sugar with a solvent. Water, acetone, and ether have been used. Then the solution containing fly factor is decanted from the sugar.

Entomologists know they have "something" in this solution. It not only makes sugar more attractive to flies but also records on the spectrophotometer, absorbing a certain length of ultraviolet light. The scientists have learned, too, that this mysterious something called fly factor is unstable in light and air as well as under high temperatures.

To sum up: the researchers don't know what they've got or what value it may have. But the promise of such a material as a fly attractant for use in insecticidal baits or traps is encouraging these workers in their efforts to isolate and learn its chemical make-up.☆

SUGAR (left) has little appeal to flies when they can have sugar plus fly factor (right).



MACHINE that sorts eggs into six groups from white to dark brown is demonstrated by A. W. Brant, Poultry Research Section head.

CARCASS of a lean meat-type hog bred at Beltsville is compared with that of an ordinary hog by animal husbandman R. L. Hiner.

4-H'ers at Beltsville

■ A TOUR OF USDA's Agricultural Research Center at Beltsville, Md., was one highlight of the Silver Anniversary National 4–H Club Camp in June in the Nation's Capital.

Two hundred outstanding boys and girls from 46 States heard ARS scientists tell about recent developments in agricultural research—and tasted some of its products.

Also attending the camp were a hundred State 4–H Club leaders, about three hundred former campers returning in celebration of the 25th anniversary of National Camp, and five young people from other lands.☆

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agrisearch notes

COTTON-BELT-WIDE field evaluation of two promising new experimental systemic insecticides—both phosphorous compounds—is now in progress.

These systemics, unlike normal insecticides, are absorbed by plants and translocated with the sap.

USDA entomologists have applied the new materials to cotton seed planted at six southern locations. These chemicals will be compared with recommended insecticides in ability to control early-season thrips, aphids, and spider mites, as well as over-wintered boll weevils.

In laboratory tests last year and in the field trials this year, the two systemics were mixed with activated carbon and applied as a cotton-seed treatment. They were not as readily translocated when applied as foliage sprays.

ARS IS LOSING two key officials by the retirement of R. W. Trullinger and O. E. Reed after distinguished careers.

Trullinger, Assistant Administrator for Experiment Stations and former Chief of the Office of Experiment Stations, retired June 1 after 43 years' service. He had charge of Federal-grant funds for agricultural research at State experiment stations and for coordination of USDA research with that of the stations. He pioneered in agricultural engineering and also worked on soils, drainage, and fertilizers.

Reed retires September 1 as Director of Livestock Research. He was Chief of the former Bureau of Dairy Industry for 26 years. For 20 years he taught at the University of Missouri, Purdue University, Kansas Agricultural College, and Michigan State College. While an educator, Reed did research on production of silage from alfalfa and grasses, and use of mineral supplements in dairy-cattle nutrition.

E. C. Elting was designated acting Assistant Administrator to continue Trullinger's work. Elting has been associated with the experiment-station program for 19 years. He formerly served with the University of Missouri and Clemson College for 11 years.

B. T. Simms, Chief of the Animal Disease and Parasite Research Branch, succeeds Reed. Simms taught and did research in animal diseases at North Carolina and Oregon State Colleges. He joined USDA in 1938 as director of the Regional Animal Disease Research Laboratory, Auburn, Ala. For 8 years he was Chief of the former Bureau of Animal Industry, planning and directing research and regulatory programs.

HOW A POTATO RESISTS SCAB disease may have been partly explained by Federal-State cooperative research at Fort Collins, Colo.

USDA plant pathologist L. A. Schaal and Colorado experiment station chemist G. Johnson found that resistant varieties have quite a bit of the chemical chlorogenic acid and the enzyme tyrosinase in the skin. These substances are especially plentiful around the potato's breathing pores (lenticels), where the scab fungus generally enters. It appears that after fungus injury to the potato, the enzyme may change the acid into toxic chemicals that kill the fungus.

The scientists also observed that cut or skinned surfaces heal with corky tissue more readily when chlorogenic acid and the enzyme are abundant. So this chemical reaction seems to be part of a potato's protective mechanism against injury.

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